VOL. 3 NO. 8 AUGUST 1986

COMPUTER DIGEST

A NEW KIND OF MAGAZINE FOR ELECTRONICS PROFESSIONALS

RETROFITTING PRINTERS

Giving new life to an old workhorse

SPEECH SYNTHESIZER FOR THE COMMODORE

Teaching Your Computer To Speak

SINGLE TRANSISTOR

Switching Circuit Design

A GERNSBACK PUBLICATION

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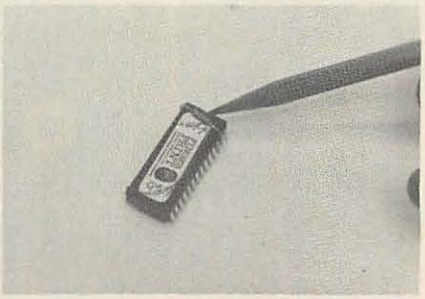

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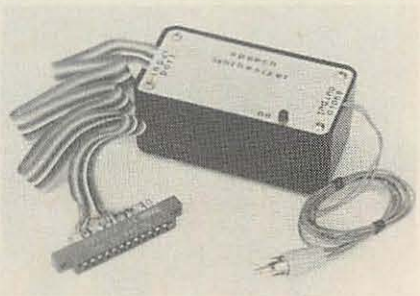

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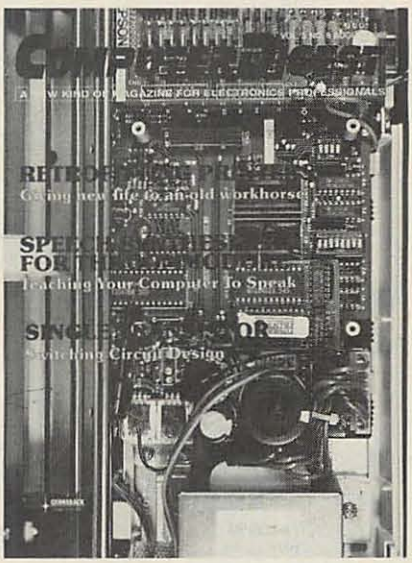
ON THE COVER

While the innards of any computer product might look like a confused maze, the article on retrofitting printers helps clear things up sufficiently so that you will have no problem in completing this work and having done so, you will have upgraded your printer. See page 6.



COMING NEXT MONTH

We've got an excellent mix of articles that should appeal to almost everybody. Leading off the next issue is an article on how to use your computer as a scanner for the CB bands that takes out all the usual frustration of channel-hopping. And you'll learn how to soup-up your computer so it performs as if it were supercharged. And to wrap things up, a build-it-yourself power controller that turns things on—and off—one at a time.

EDITORIAL

RM5241...

■Don Stoner has been an electronics writer all his life. As such, he's been keeping his finger on the pulse of hobby electronics, and for my own part, when Don says something, I listen.

Right now, Don is saying something, and it's important. It's important to everybody that's interested in computers, so if you're reading these words, it's important to you. One of the newer areas of technology in computer science, is Packet Radio. You've seen articles on this same subject in **ComputerDigest**. And you probably realized that to take advantage of this, you require an amateur radio operator's license. If you *have* such a license, you probably were more than passingly interested in the article. If you didn't have, you may have wondered at the feasibility of getting such a license, just to make better use of packet radio techniques with your computer.

To oversimplify, packet radio permits you to transmit data from place to place without the use of a modem or telephone line.

Don Stoner has peitioned the FCC to create a band for use by the general public, for packet radio. It will operate at 500 kilobytes instead of 1200 baud, and most important, would make packet radio technology available to any computer owner without his having to take an amateur radio operating examination or posess such a license.

I haven't seen the details of Mr. Stoner's petition, but I'm certainly behind the spirit and general principles of it. I urge you to write to the Federal Communications Commission, Washington, D.C. 20554 and express support of RM5241. It's going to be good for us all.

Byron G. Wels

Byron G. Wels
Editor

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LETTERS

Last call

As you may know, SAMS publishes Computerfacts™ technical service data for the Timex-Sinclair 1000 ZX-81 computers as well as for many other personal computers, disk drives, printers and monitors. Our package for the Timex-Sinclair units is product #08969-6 with a $19.95 retail price. We'd like to be included in your listing.—Dwayne Gott, Howard W. Sams & Co., Indianapolis, IN.

Mr. Gott, the list wouldn't be complete without offering the fine Sams publications. For those who need it, the full address is 4300 W. 62nd St., Indianapolis, IN 46268. And for you others who may have put off writing, move fast. We're ready to start preparing it now.

Which is best?

Our local computer club has been arguing about which is best, WordStar, PeachText or pfsWrite. Which do you like best?--R.W., Bloomington, IL.

Never argue about politics, religion or word-processing programs. I use PeachText because I'm most-familiar with it, having learned on that. But recently I used a friend's new Tandy 1000 with pfsWrite, and had no problems. I like that too. I never did get to try WordStar

Home made?

Why is it that home-brew projects always seem to *look* home-brew? Why can't they be "dolled up" to look like commercial equipment?—P.T., Yuma, AZ.

They can—and should! But experimenters are usually satisfied if something they build just works. A little paint, some nice decals, and a little thought, and you can put together a project that looks as if you bought it!

Getting older

How long has **ComputerDigest** been around now? I certainly enjoy the concept of a "magazine within a magazine" and hope it continues.—S.B., Lyndhurst, NJ.

The first issue was published in May, of 1984. We're now in our third year, and still going strong. Thanks for asking. It certainly doesn't seem that long!

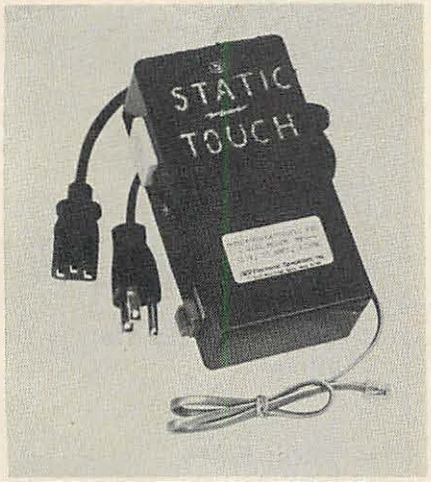
A saver!

I've been using my computer for quite a while now, and store everything to floppy disk. Result? A huge collection of disks, many of which contain information I no longer need. How can I save what I *do* want, and re-use those disks?—W.P., Miami, FL.

Simply transfer the desired info to a blank, formatted disk and then format the old disk for re-use. Just save the files you want to keep.

COMPUTER PRODUCTS

For more details use the free information card inside the back cover

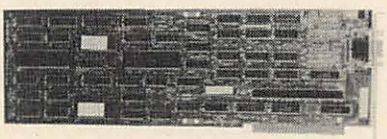


CIRCLE 11 ON FREE INFORMATION CARD

PORTABLE COMPUTER PROTECTION, is provided by the Modem/Power/Static/Pac model *MPS-1,* which combines broadband AC power filtering, extended range spike suppression, modem RF filtering, modem spike suppression, and a static discharge plate.

Power is available from a conventional three-prong outlet and a CEE-22 universal portable computer power connector. A 6' power cord is provided. Modem connection is through standard modular RJ-11 connectors. Static discharge is integrally designed into the unit. The model *MPS-1* is priced at $199.95.—**Electronic Specialists, Inc.,** 171 South Main Street, Natick, MA 01760.

DISPLAY ADAPTER, *The Modular Graphics Card*®, achieves complete compatability because it looks like an IBM color graphics card to a PC system and its software and supports PC-compatible monochrome, RGB color, or composite monitors. Monochrome monitors portray colors as shades. *The Modular Graphics Card* displays up to 16 colors (on color monitors; up to 16 shades on monochrome monitors),



CIRCLE 12 ON FREE INFORMATION CARD

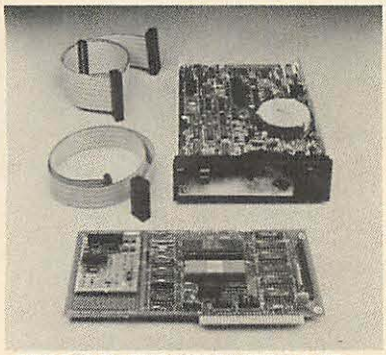
full-screen graphics, high-resolution test, and flicker-free scrolling.

Documentation includes tables of jumper and DIP-switch settings for optimum rersults from most popular monitors; for monitors not listed, a special software utility (also included) determines settings based upon on-screen displays. The card includes connectors for a light pen and an RF modulator. In addition, the card comes with RAM disk and print spooler software.

The Modular Graphics Card is priced at $395.00.—**Paradise Systems, Inc.,** 217 East Grand Avenue, South San Francisco, CA 94080.

TAPE BACKUP SYSTEM, model *WD60Ti,* is a 60-megabyte, ¼" internal, tape-backup system that enables IBM, PC, XT, AT, and certain compatible users to backup data from a hard disk.

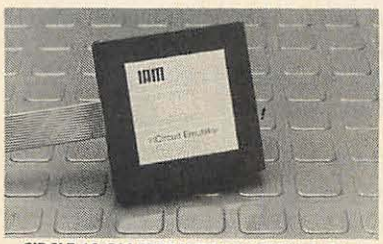
The model *WD60Ti* comes with menu-driven, user-friendly software utilities; it draws its power from the host CPU's power supply, and does not require any additional power supply when operating inside an IBM PC AT. It uses a standard QIC-36 interface.



CIRCLE 13 ON FREE INFORMATION CARD

Mirror-image backup with the model *WD60Ti* takes only one minute per 5-megabytes. The unit also performs selective file backup, which saves tape space and allows the user to select what data to backup. The model *WD60Ti*'s built-in intelligence means that the user does not have to remember the last file modified to back it up. The model *WD60Ti* has a suggested retail price of $1495.00.—**Western Digital,** 2445 McCabe Way, Irvine, CA 92714.

IN-CIRCUIT EMULATORS, are designed especially for Repair Technicians and Design Engineers. Small and compact (3" × 3" × ½"), these high-function emulators draw their power from the target system. (Optional power supplies are available with some models.) Since they plug right into the design board, the user gets full-speed emulation—with none of the attendant target disturbance inherent in traditional emulator designs,



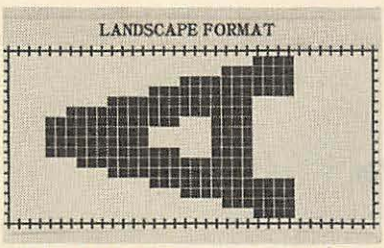
CIRCLE 14 ON FREE INFORMATION CARD

Despite the small size and low price (models start at $500.00) these emulators are powerful. Their two-microprocessor design offers the user access to all memory addresses, software breakpoints, print points, both Hex and ASCII displays, assembly and disassembly of memory, and the ability to modify a memory location (or fill RAM w/constant) and read and load Hex files.

In addition the IAM In-Circuit Emulators provide the user with easy-to-use commands that execute, delay, and/or repeat instructions for thorough system testing. Models presently available are the *8085, 8088, Z80,* and the model *NSC800.*—**IAM,** PO Box 2545, Fair Oaks, CA 95628.

FONT UTILITIES, for the Hewlett-Packard LaserJet Plus includes the *FontGen Utility,* the *Font Printer Utility,* and the *Landscape Utility* (shown).

The *FontGen Utility* is a font editor/generator that allows HP users to modify existing donwloadable fonts and to create new font designs. The user can design special symbols, such as logos, signatures, or technical symbols and add them to a font. Characters from different fonts can be combined. The user can also alter existing fonts using functions such as italicize, enlarge, reduce, or reverse image. The *FontGen Utility* has a suggested retail price of $250.00.



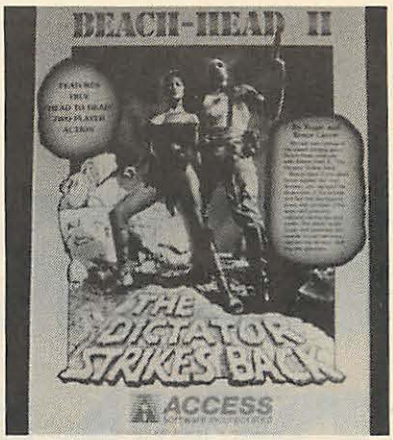
CIRCLE 15 ON FREE INFORMATION CARD

The *Font Printer Utility* allows the HP user to print a hard copy of the character's bit map, as well as a listing of the components, such as the baseline position or left boundary. A single character, or a range of, can be displayed using the laser printer or a standard printer. The *Font Printer Utility* has a suggested retail price of $50.00.

The *Landscape Utility* rotates characters, allowing a typeface to be used in the landscape mode. The software also revises the font header and character header, providing the user with a landscape version of any downloadable font. The *Landscape Utility* has a suggested retail price of $50.00.—**VS Software,** 2101 South Broadway, PO Box 6158, Little Rock, AR 72216.

ACTION/STRATEGY GAME, *Beach-Head II,* is subtitled, "The Dictator Strikes Back."

Beach-Head II features true action for two players or one player against a computer opponent. The game has multiple playfields, scrolling playscreens, hi-res graphics, various difficulty levels, and a "practice" mode. It is available on disk with a price of $34.95.—**Access Software Inc.,** 2561 South 1560 West, Woods Cross, UT 84047.



CIRCLE 16 ON FREE INFORMATION CARD

PROFESSIONAL COMPUTER, the 1-800-Floppys, model *XT,* is designed for the experienced computer user; it is a dual disk drive, 640K, IBM-compatible personal computer, and comes with everything needed to run IBM-compatible software packages. There is a 135-watt power supply, TTL monochrome monitor with a Hercules-type graphics card, eight slots for adding boards, a parallel port board plug, and a Keytronics-type keyboard.

CIRCLE 17 ON FREE INFORMATION CARD

The model *XT* comes with a 120-day warranty, which includes all parts and labor, and the customer may use the system up to 30 days in order to test its compatibility with his or her software. Should it prove incompatible, the customer is entitled to a complete refund, including return freight charges. The model *XT* is priced at $999.00.—**1-800-Floppys,** 22255 Greenfield Road, Southfield, MI 40875.

RETROFITTING PRINTERS

Making new printers even better.

Herb Friedman

■Unlike the printers that use typewriter-style elements with fully-formed characters, such as a daisy wheel, a matrix printer uses a pattern of dots to create characters and graphic symbols. In the low-cost printers used with personal computers the dots are generated by 7 to 24 solenoid-activated wires contained in a print head. Regardless of how the electromechanical system moves the printhead and "fires" the wires to produce printed dots, the decision as to how to move the print head and what wires to "fire" to create a specific character or graphic is generated by a microprocessor in the printer. The programming for the actual character/graphic pattern is stored in one or more ROMs; or in RAM when the printer lets the user design his own character set (font). In some modern printers the user can combine characters stored in ROM with user-generated characters stored in RAM.

Often, the difference between printers and character sets is the ROM, all else is the same. For example, the Epson MX-80 printer originally provided the ASCII character set and the block graphics of the Radio Shack TRS-80 Model I computer. When the Model I was displaced as the number 1 personal computer a new generation of Epson MX-80, called the MX-80 +, and a later model called the MX-80 *Graftrax* (or MX-80 III) provided the ASCII character set and italic characters. The difference between models of the MX-80 was the ROM(s) programmed for the characters, graphics and functions. In later models the ROMs were programmed to provide a backspace, then a conventional underscore, super and subscripting, new graphics, and new printing enhancements.

Later, the MX-80 became the IBM Graphics Printer, and although the ROM provided the conventional ASCII characters and control codes, instead of the italic characters and Epson-type graphics, the printer was programmed for the IBM foreign character set, the IBM Greek and math symbol set, the special IBM characters, and two distinct character/symbol/graphic sets. The label on the panel now said IBM rather than Epson. The printer was still an MX-80, but by substituting an "IBM ROM" the printer now generated a new set of characters, symbols and graphics.

More than characters

The ROM generates more than characters and graphics; It determines the features that can be accessed through software-driven printer codes and—depending on the printer—the functions of the operating controls, which are usually the three pushbutton switches for the *ON LINE, FORM FEED* and *LINE FEED* functions. If you could program your own ROM you could force a printer to respond differently to

the three pushbuttons. You could, for example, program the ROM so that pressing the *ON LINE* switch three times caused the printer to automatically shift to double-width characters, while pressing the button six times might cause the printer to automatically skip over the perforations of continuous-form (pinfeed) paper.

Fingerprinting

If you could program your own ROM it wouldn't be worth the effort because for about $60. you can retrofit most popular printers with a custom ROM kit called a "Fingerprint" (Dresselhaus Computer Products, 837 E. Alosta Ave., Glendora, CA 91740), which can make an old workhorse emulate the character/graphics set of the latest printers (really the IBM character set), provide the most-popular operating features, and allow you to directly access the most popular printer functions through what is normally the three operating pushbuttons—rather than software.

Beep for special functions

A Fingerprint converts the printer's three operating pushbuttons into a special function selector. If you touch the *ON LINE* button, it switches the printer on or off line. Hold the button down for one second, and it switches the printer to Fingerprint mode and beeps. You are now able to select many printer functions by beeping the *ON LINE* button. The chosen function depends on the number of beeps.

If you're using an FX-80 printer and want proportional printing, from the chart supplied, you know three beeps means proportional. Press the *ON LINE* button for three beeps, then press the *FORM FEED* button which programs the printer for the beeped function, in this case, proportional printing. Pressing the *LINE FEED* button ends the beep programming mode and restores the normal functions to the buttons. You can stack several functions. For example, three beeps for proportional printing, then four beeps for emphasized printing, to produce emphasized proportional printing.

Custom Fingerprint retrofits are available designed to use the particular capabilities of the most commonly used matrix printers: The Epson MX, FX and RX, the IBM Graphics Printer, The C. Itoh Prowriter I and II, the NEC 8023A, the Star Gemini 10 and 15, the Okidata Microline Series, and the Apple Dot Matrix printers.

Many functions

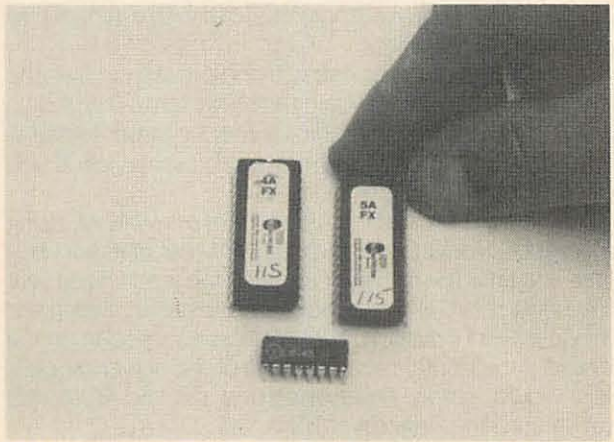
The functions you can program through Fingerprint depends on the printer. Because of improvements in printers, Fingerprint provides more features in later printers than in older models. For example, the MX-80 family of printers and IBM Graphics Printers provide:

BEEPS	FUNCTION
1	Reset
2	Compressed
3	Double-wide
4	Emphasized
5	Double-strike
6	Perforation Skipover
7	Left Indent
8	8 lines/inch
9	Italics
10	Fine print

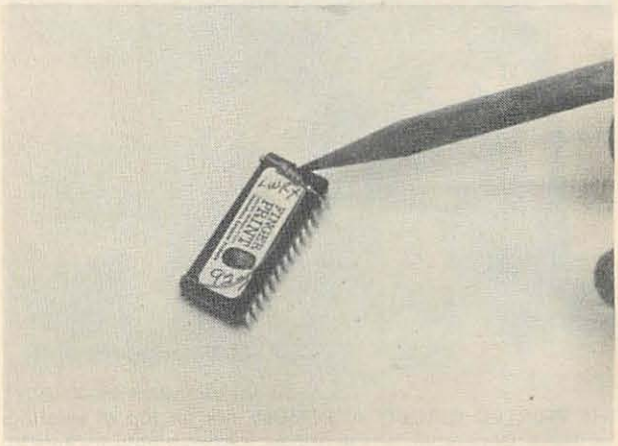
A more-modern printer such as the RX-80 and RX-80 + series can provide:

BEEPS	FUNCTION
1	LetterWriter(NLQ)
2	Condensed
3	Elite
4	Double-wide
5	Emphasized
6	Double-strike
7	Perf-skip
8	Left indent
9	Italics
10	Underline
11	Fine print
12	8 lines/inch
13	Paper out disable
14	Slash zero
15	8 ½ inch paper

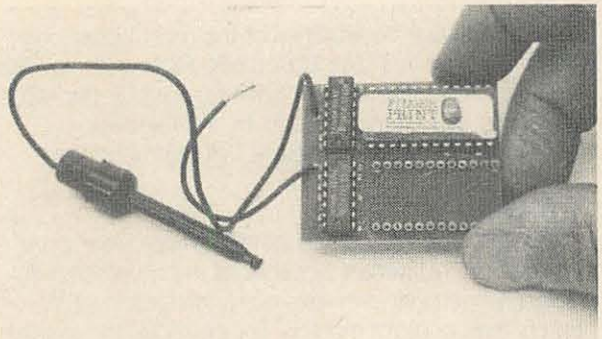
The *LetterWriter* function in the list is Near Letter Quality



ON NEWER PRINTERS, three plug-in replacement ROMs form the entire printer retrofit. Substitute them for the existing ROMs and they provide up to 15 one-touch features including NLQ printing quality.



WHEN THERE ARE SEVERAL VERSIONS of a printer the Fingerprint ROM is pre-wired with a strapped resistor that is either left in place or cut with diagonal cutters. This avoids having to modify existing wiring in the printer.

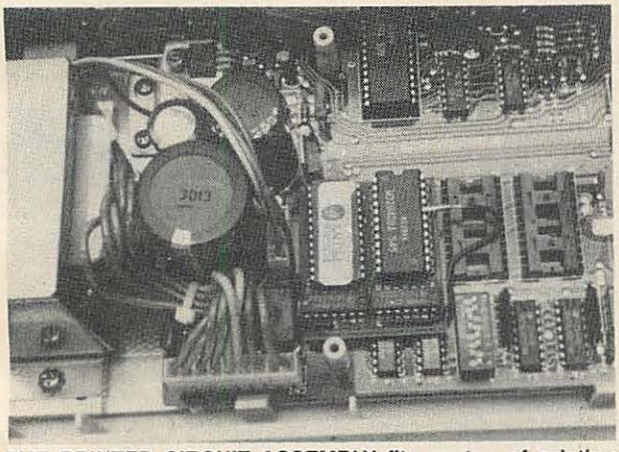


THE IBM GRAPHICS PRINTER and other MX -80 based models need a small printed circuit assembly that substitutes for the existing printer ROM. The parallel rows of terminals on the board create a 24-pin socket to which the original ROM is moved. The mini-clip provides a solder-free connection to exisiting printer wiring.

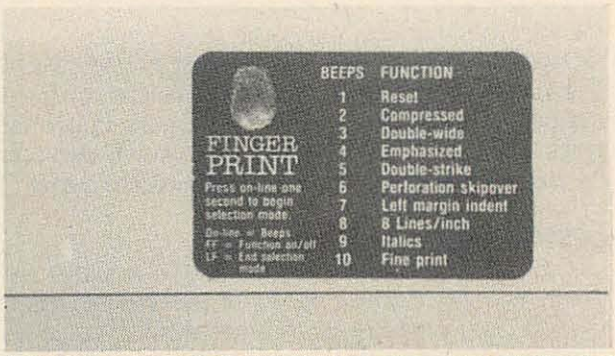
(NLQ), a character set which doesn't exist in this particular printer as supplied. In some printers, Fingerprint can synthesize both NLQ characters as well as the special IBM character set, graphics and symbols. If you have an older printer and an IBM-compatible computer your old printer will reproduce the IBM characters and graphics if Fingerprinted.

Stacking functions

You aren't limited to programming one Fingerprint function at a time. Any functions listed that aren't mutually exclusive can be stacked. Suppose you are printing the listing of a BASIC program to be stored in a ring binder. You could program emphasized characters for clarity, left margin offset to clear the rings and perforation skipover. Or if you'd like to print a 132 column spreadsheet with as many lines as possible on standard paper. Use Fingerprint to program both compressed/condensed characters and 8 lines/inch spacing. But you couldn't program *emphasized compressed characters* because they are usually mutually exclusive—the printer won't recognize



THE PRINTED CIRCUIT ASSEMBLY fits on top of existing hardware. Depending on the printer, the two empty sockets to the right of the Fingerprint might be filled with ROMs: Just ignore them. They don't get in the way because the circuit board sits above them.



A LABEL AFFIXED TO THE FRONT of the printer tells what functions can be programmed directly from the printer's controls. This label for the IBM Graphics Printer shows 10 beeped functions.

the commands and will default to standard size for 10-pitch characters.

Turn them off

Fingerprint functions are turned off by entering the beep code a second time. If your Fingerprint retrofitted printer provides the option of conventional zeroes or slashed zeroes, when you want slashed zeroes, set the printer *OFF LINE* to stop the printing, program the slahed zeroes and resume printing. When you want to go back to conventional zeroes, stop printing, program the conventional zeroes and resume printing. The second slashed zero program turns the function off. This can be repeated as often as you like.

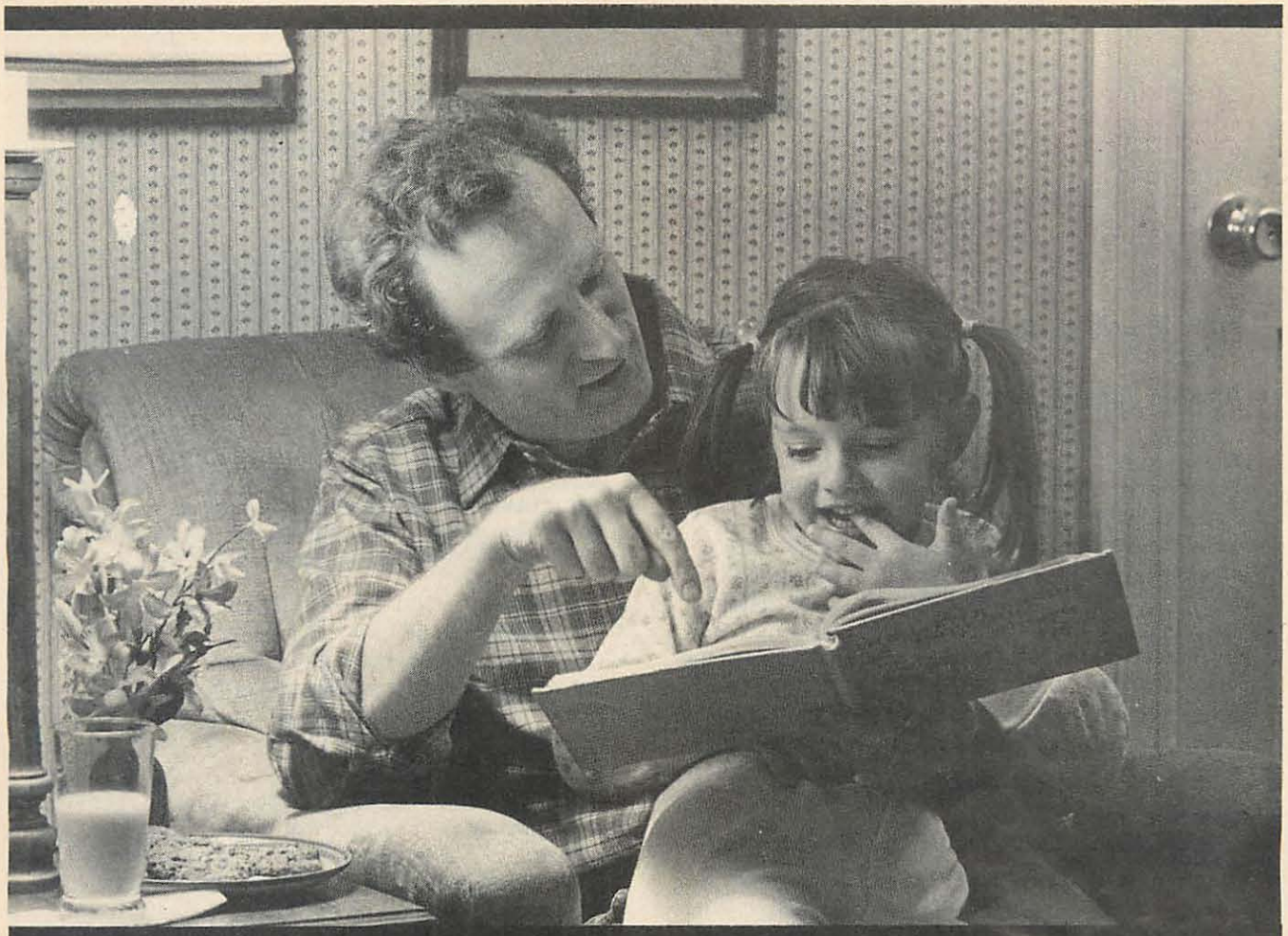
Installing the retrofit

A Fingerprint retrofit is a simple task because it only involves opening the case and replacing or moving one to three ROMs which are socketed—no desoldering is involved. Sometimes the retrofit is a direct swap for the existing ROM, in other cases it's a small printed circuit assembly that substitutes for the existing ROM, with the original factory-installed ROM moved to a socket on the PC board. In the newer printers, like the FX and RX-80s you simply swap ROMs. In the MX-080 based printers and the IBM Graphics Printer you remove the main ROM (there can be one to three), substitute a small printed circuit assembly, and install the original ROM in an empty socket on the circuit board. Then you connect a lead with a mini-clip to another IC terminal.

Of all the retrofits, the one with the printed circuit is the most difficult. "Difficult" being a relative term. The photos of a retrofit for an IBM Graphics Printer Fingerprint installation show it's an easy and not troublesome job if you don't rush it.

Imagine the printed circuit board is a new ROM. Using a large screwdriver, work the main ROM out of its socket, a little at a time so you don't damage the leads. Then seat the printed circuit in the now-empty socket, attach the mini-clip, and install the ROM in the empty socket on the board. If the printer had been one of the newer models, you would simply have discarded the old ROM and substituted the Fingerprint ROM.

Finally, install the case and apply a provided plastic sticker—listing the Fingerprint functions and their beeps, to the front of the printer.◀CD▶



To 27 million Americans, this scene is a fairy tale.

Because 27 million American adults can't read a child's bedtime story, can't read a street sign, can't read...period.

Functional illiteracy is a problem that now affects 1 out of 5 American adults. It can rob them of a decent living; it can rob them of self-respect; it can rob them of the simplest of human pleasures...like reading a letter from a friend.

You can change that by supporting the fight against illiteracy. Your tax-deductible contribution to the Coalition for Literacy will be used two ways. First, it will help continue the campaign to increase public awareness of the problem. Second, it will help us generate new resources for literacy.

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SPEECH SYNTHESIZER

How to add a voice to your Commodore 64.

Ricardo Jiminez and Adrian Valle

If you want to increase the potential of your Commodore 64 with a speech synthesizer this project is for you. When your computer talks, you can have many advantages; for example, if you are processing information with numbers or letters, it will be a lot easier, because you will hear the number pressed on the keyboard without looking at the screen. And your children can learn to speak and spell by looking at the letters and numbers while they are listening to the correct pronunciation. Another advantage is that all the components for this project are available at any Radio Shack store.

Construction

The construction of the circuit is not critical, since only two chips are involved. You can assemble a working version on a solderless breadboard in less than two hours. We assembled the project in a small plastic experimenter's box. The 3.12 MHz crystal XTAL-1 can be replaced by a 3.14 MHz crystal, part number X004 for $1.35, distributed by Digi-Key Corp. (P.O. Box 677, Thief River Falls, MN, 56701-9988).

Crystal XTAL-1 and capacitors C1 and C2 should be placed as close to IC1 as possible. A 12/24 pin card-edge connector was used to interface the electronic circuit with the C64 computer.

About the audio output; if you own the Commodore video monitor model 1701 you don't have to use an external speaker, just plug the audio output cables into the audio input of the monitor (located at the rear of the screen) via a phono plug. In this case the volume is controlled by the volume control of the monitor.

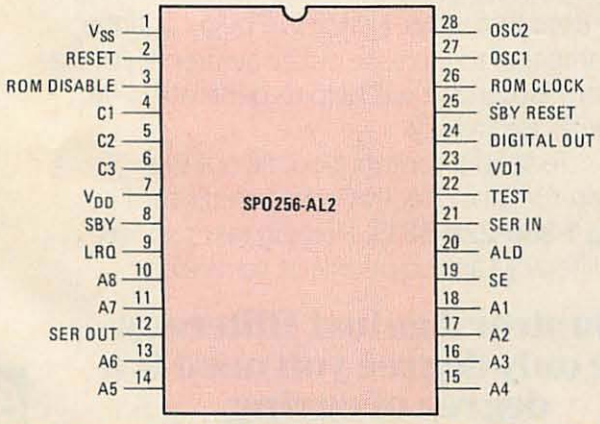
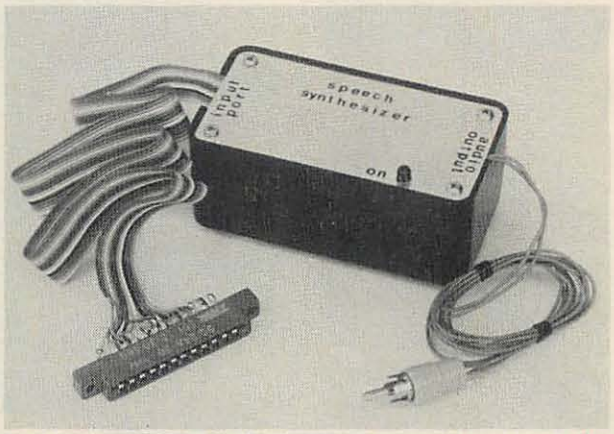


FIG. 1—PINOUT DIAGRAM for the SPO256-AL2. Refer to text for a detailed explanation.



THE COMPLETED SYNTHESIZER packaged and ready for use. As you can see, it's a compact unit that doesn't occupy much space considering the big job that it does.

Finally, the 5-volt DC power supply is provided by the Commodore 64 (pin 2 of the user port), which delivers a maximum current of 100 mA. Since the circuit has a current consumption of 90 mA, such power is suitable for this project.

About the SPO256-AL2

The speech processor (SPO256-AL2) is a single chip N-Channel MOS LSI device that is able, using its stored program, to synthesize speech or complex sounds. Figure 1 shows the pin configuration. We will look at the most important functions of the SPO256-AL2 which permit us to interface with the C64 computer.

A1-A8: 8-bit address which defines any one of 256 speech entry points. ALD: ADDRESS LOAD. A negative pulse on this input loads the 8 address bits into the input port and starts a speech command. This input is controlled by PC2 from the C64 computer.

SBY: STANDBY. Stays high until an addrress is loaded, then it goes low until the chip stops talking. This output indicates to the C64 computer when the chip is ready.

DIGITAL OUT: Pulse width modulated digital speech output which, when filtered by a low-pass filter and amplified, will drive a loudspeaker.

Let's start with some basic linguistic terms in order to understand how this project works.

Phoneme. This Is the basic unit of distinctive sound. It represents different sounds depending on its position within a word. Each of these positional variants is an allophone of the same phoneme.

How to use allophones

When you use allophones you have to think in terms of sounds, not letters. And because each sound is acoustically different depending upon its position within a word, this method is called "Allophone Speech Synthesis." With this technique you can synthesize an unlimited vocabulary by addressing the 59 allophones plus 5 pauses in the appropriate sequence. Figure 2 shows the 64 allophone address table which are contained in the 16K ROM of the SPO256-AL2. The first column (decimal address) is the respective binary address for each particular sound. Since there are 64 addresses only, you will need six

DECIMAL ADDRESS		ALLOPHONE	SAMPLE WORD	DURATION
000		PA1	PAUSE	10MS
001		PA2	PAUSE	30MS
002		PA3	PAUSE	50MS
003		PA4	PAUSE	100MS
004		PA5	PAUSE	200MS
005		/OY/	Boy	420MS
006		/AY/	Sky	260MS
007	*	/EH/	End	70MS
008		/KK3/	Comb	120MS
009		/PP/	Pow	210MS
010		/JH/	Dodge	140MS
011		/NN1/	Thin	140MS
012	*	/IH/	Sit	70MS
013		/TT2/	to	140MS
014		/RR1/	Rural	170MS
015	*	/AX/	Succeed	70MS
016		/MM/	Milk	180MS
017		/TT1/	Part	100MS
018		/DH1/	They	290MS
019		/IY/	See	250MS
020		/EY/	Beige	280MS
021		/DD1/	Could	70MS
022		/UW1/	To	100MS
023	*	/AO/	Aught	100MS
024	*	/AA/	Hot	100MS
025		/YY2/	Year	180MS
026	*	/AE/	Hat	120MS
027		/HH1/	He	130MS
028		/BB1/	Business	80MS
029	*	/TH/	Thin	180MS
030	*	/UH/	Book	100MS
031		/UW2/	Food	260MS
032		/AW/	Out	370MS
033		/DD2/	Do	160MS
034		/GG3/	Wig	140MS
035		/VV/	Vest	190MS
036		/GG1/	Got	80MS
037		/SH/	Ship	160MS
038		/ZH/	Azure	190MS
039		/RR2/	Brain	120MS
040	*	/FF/	Food	150MS
041		/KK2/	Sky	190MS
042		/KK1/	Can't	160MS
043		/ZZ/	Zoo	210MS
044		/NG/	Anchor	220MS
045		/LL/	Lake	110MS
046		/WW/	Wool	180MS
047		/XR/	Repair	360MS
048		/WH/	Whig	200MS
049		/YY1/	Yes	130MS
050		/CH/	Church	190MS
051		/ER1/	Starter	160MS
052		/ER2/	Bird	300MS
053		/OW/	Close	240MS
054		/DH2/	They	240MS
055	*	/SS/	Vest	90MS
056		/NN2/	No	190MS
057		/HH2/	Hoe	180MS
058		/OR/	Store	330MS
059		/AR/	Alarm	290MS
060		/YR/	Clear	350MS
061		/GG2/	Guest	40MS
062		/EL/	Saddle	190MS
063		/BB2/	Business	50MS

FIG. 2—ALLOPHONE ADDRESS TABLE.This will prove extremely handy when setting up your synthesizer.

input address pins to make all these combinations. The second column represents all the allophone sounds (except pauses PA1 to PA5). The third column shows how each allophone sounds in a sample word. The fourth column is the duration in milliseconds for each.

Allophones marked with an asterisk can be doubled; in the word "four" the "f" sound is long, therefore, this word must be formed as follows: "FF, FF, OR, PA5." Note that PA5 is not a sound, is a pause necessary to make the chip stop talking the last allophone.

Each allophone has its own address and sound. To demonstrate this let's see how it happens. The initial K sound (KK3, address 8), used in words like "comb" sounds different from the K's in words like "can't." These small variations are due to the vowel which follow them, in this case, "o" and "a."

The computer controls the SPO256-AL2 with simple software. Let's look at the important instructions used in the programs. First we need to access the user port as follows. Pin C, D, E, F, H, and J (PBO to PB5) in the output mode. Pins K and L (PB6 and PB7) in the input mode. This is made with the statement.

POKE 56579,63

Where PBO to PB6 send the desired address to the speech processor IC1 (see Fig. 3). And PB6 receives the logic status of the STANDBY output (pin 8 of IC1). Remember that the decimal number 63 is equal to 00111111 in binary code. Therefore, when we send an address the ALD input is activated and the chip (IC1) starts talking. Then the computer reads the user port to know the STANDBY status (PB6) which tells the computer when the chip is ready to be triggered again. The instruction PEEK(56577) reads the user port, but we need to read PB6 only which represents the decimal number 64. This is made by using the AND function. If PB6 is a logic "1" then the computer sends a new address.

Testing the speech synthesizer

As was mentioned before, the poke statement (line 20) is used to access the user port. Let's begin with the program shown in Fig. 4. With this program you can listen the particular sounds of the 59 allophones. The FOR-NEXT loop (line 30) is used to increment the value

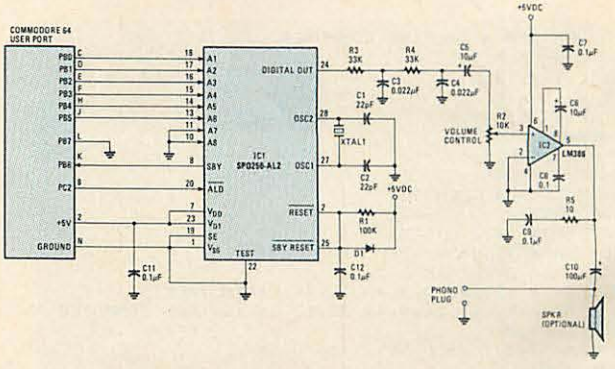


FIG. 3—SCHEMATIC DIAGRAM is relatively simple, uses only few components. Refer to the text for a full and complete explanation.

```
10 REM ALLOPHONES EVALUATION
12 REM BY R. JIMENEZ AND A. VALLE
20 POKE 56579,63
30 FORA=0 TO 63:PRINTA
40 POKE 56577,A
50 POKE 56577,0
60 PB=PEEK(56577)
70 F=PBAND64
80 IF F<>64 THEN 60
90 NEXT A
100 POKE 56577,1
120 END
```

FIG. 4—THIS SIMPLE, BRIEF PROGRAM allows you to evaluate the 59 available allophones.

of A from D to 63. The purpose is to use the variable A in the POKE statement (line 40) in order to address each allophone. The poke 56577,0 clears and prepares the user port for the next data. The PEEK statement (line 60) reads the user port, storing its value in the variable PB. Then PB is compared with the number 64 on the IF statement (line 80). If F is not equal to 64, that means that the speech synthesizer is not ready to receive new data. And the computer goes back to line 60 automatically. Otherwise, new data is sent.

The POKE Statement 56577,1 makes the chip (IC1) stop saying the last allophone. If you wish to listen to the allophones slowly, just press the (CTRL) control key.

Using the speech synthesizer

Making words with the SPO256-AL2 is easy, all you have to do is to look for the sounds you need from the Allophone Address Table. Figure 5 shows a program which makes the speech synthesizer say the sentence "I am a talking computer." This program works like the first one (fig. 4), using the same instructions to write and read by means of the user port. The only difference is that the data (lines 103-110) are going to be sent with the READ statement (line 70). Note that the data are written in decimal numbers. The words used in this sentence were taken from the dictionary included with the SPO256-AL2 package.

Figure 6 shows a routine that can be used for data processing. This routine makes the speech synthesizer say numbers from 0 to 9 when you press the respective key number. Lines 65 to 100 are used exclusively to assign the data found in lines 100 to 128 to the dimensioned variables A (I) and B (I,J). Here you can

```
10 REM I'M A TALKING COMPUTER
60 POKE 56579,63
65 FORJ=1TO 27
70 READ A
80 POKE 56577,A
85 POKE 56577,0
90 PB=PEEK(56577)
94 F=PBAND64
96 IF F<>64 THEN 90
100 NEXT J
102 DATA 24,6,0:REM    I
104 DATA 7,7,16,2:REM  AM
106 DATA 24,2:REM      A
108 DATA 13,23,23,2,42,12,44,0:REM TALKING
110 DATA 42,15,16,9,49,22,13,51,1,4:REM COMPUTER
160 RESTORE
170 FORT=1 TO 500:NEXTT:GOTO 65
200 END
```

FIG. 5—USE THIS PROGRAM, and you'll hear your computer actually say the words "I am a talking computer."

PARTS LIST

Resistors
All resistors ¼watt, 5% unless otherwise specified
R1—100,000 ohm
R2—10,000 ohm trimmer potentiometer
R3, R4—33,000 ohm
R5—10 ohm,

Capacitors
C1, C2—22pF., ceramic disc
C3, C4—0.022μF., ceramic disc
C5, C6—10μF., 10 volts, electrolytic
C7, C8, C9, C11, C12—0.1μF., ceramic disc
C10—100μF., 10 volts, electrolytic

Semiconductors
IC1—SP0256-AL2 speech processor (Radio Shack 276-1784)
IC2—LM386 audio amplifier (Radio Shack 276-1731)
D1—1N914 switching diode

Other components
XTAL-1—3.12 MHz crystal (see text)
SPKR—8-ohms (optional, see text)
12/24 pin card-edge socket (Jameco Electronics)
1.5 ft. - 14-conductor ribbon cable
Insulated phone plug (Radio Shack 274-321)
Experimenter box (Radio Shack 270-231)
Experimenter's IC perfboard (Radio Shack 270-150)
28 pin IC socket
8 pin IC socket

```
12 REM DATA PROCESSING
15 REM BY R. JIMENEZ AND A. VALLE
50 PRINT"(SC)"
60 POKE 56579,63
65 FOR I=0 TO 9
70 READ A(I)
75 FOR J=1 TO A(I)
78 READ B(I,J)
100 NEXT J,I
110 DATA 4,43,60,53,4 :REM          ZERO
112 DATA 5,57,15,15,11,4:REM         ONE
114 DATA 3,13,31,4 :REM              TWO
116 DATA 4,29,14,19,4   :REM        THREE
118 DATA 4,40,40,58,4  :REM         FOUR
120 DATA 5,40,40,6,35,4:REM         FIVE
122 DATA 8,55,55,12,12,2,41,55,4:REM SIX
124 DATA 8,55,55,7,7,35,12,11,4:REMSEVEN
126 DATA 4,20,2,13,4  : REM        EIGHT
128 DATA 5,56,24,6,11,4  :REM       NINE
150 V=V+1
160 IF V=10 THEN V=0 : PRINT"(SC)"
170 PRINT"  VALUE OF X(";V;")";
200 GET C$:IF C$="" THEN 200
205 C=ASC(C$)
210 IF C<48 OR C>57 THEN 200
215 C=C-48 : PRINTC
217 POKE 56577,0
220 FOR I=1 TO A(C)
230 POKE 56577,B(C,I)
240 POKE 56577,0
250 PB=PEEK(56577)
260 F=PB AND 64
270 IF F<>64 THEN 250
280 NEXT I : POKE 56577,1
290 GOTO 150
300 END
```

FIG. 6—THIS PROGRAM will cause your computer to clearly speak each number when the appropriate number key is pressed.

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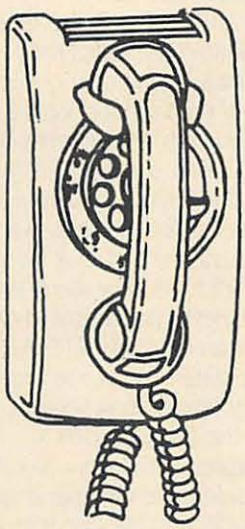

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27512	64Kx8	250 ns	$28.00
27C256	32Kx8	250 ns	7.85
27256	32Kx8	250 ns	5.45
27128	16Kx8	250 ns	3.90
27C64	8Kx8	200 ns	5.10
2764	8Kx8	250 ns	3.45
STATIC RAM			
43256L-12	32Kx8	120 ns	$50.00
6264LP-15	8Kx8	150 ns	3.10
6116LP-3	2Kx8	150 ns	2.10

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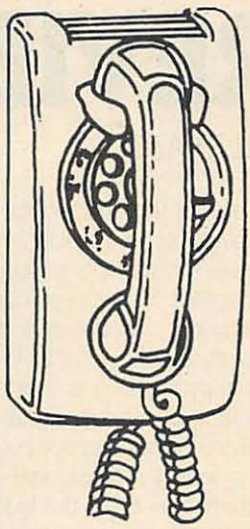

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see how A (I) contains the data that the speech synthesizer will use to pronounce a particular word. In this case ten numbers can be pronounced. For example, A (I) holds the number 4 when the variable "I" has a value of 0. And the statement READ (line 70) is executed by the computer. That means that the word "zero" will be spoken by the speech synthesizer, by just sending the four data contained in the vector B (I,J) for values of "I" equal to zero with "J" varying 1 to 4.

The FOR-NEXT loops are used as an auxilliary to the statement READ. Observe how A (I) holds the first data to be used as a variable of the statement FOR (line 75), in order to read to exact quantity of data for each spoken number. Data from lines 110 to 128 are the decimal number values which we need to make the speech synthesizer talk. Vector A (I) will store the first data contained in such lines (4, 5, 3, 4, 4, 5, 8, 8, 4, 5), which as we said before indicates the data contained in the vector B (I, J) respectively. We recommend that you compare these numbers with the allophone address table (fig. 2). For example, the data of line 110 forms the word "ZZ YR OW PA5" where the respective data are 43, 60, 53, and 4.

Lines 150 to 215 give an example of how to make the speech synthesizer more versatile. The screen will display "VALUE OF X (V)?" where V varies from 0 to 9.

The A (C) works as a variable in line 220 of the statement FOR, which means that "I" varies from 1 to the A (C) value, where C indicates the number that will be spoken. Line 217 POKEs a zero so that the new data can be accepted without problems. Line 240 serves the same purpose. And lines 250 to 270 are used to read the STANDBY condition as we explained before.

Finally, the capacity of the speech synthesizer depends upon the imagination of the user. And we hope you enjoy this project as much as we did.

SOFTWARE REVIEW

TELEPATCH—

■It seems that just about everything, from business documents to a student's homework, to family announcements, is polished to perfection with a word processor. By the time one adds up the cost of the computer, disk drives and software needed for word processing they're into big bucks—way beyond what word processing is worth to a small service shop, or a student, or the typical family of 3.85 persons.

Because word processing isn't cheap, one of the best-selling professional-quality word processing systems has been the budget-priced Radio Shack Color Computer (known as the CoCo) and an inexpensive word processing program, Telewriter-64. Together, they provided most of the modern word processing features long before they were available for the IBMs, Apples, and other "office computers." Since Telewriter-64 can intermix tape and disk text files it far outclasses anything for small business and home-and-family use because the user can grow from a cassette-based word processor into a disk system without losing the cassette files.

The only problem with the CoCo system is that compared to the most modern high-performance word processors, such as WordStar 2000 and pfs:WRITE, Telewriter-64 lacks a few conveniences, such as a pure block move instead of a block copy and delete. Thanks to an enhancement software known as TELEPATCH, Telewriter-64's limitations are almost entirely eliminated, and in the process the CoCo has been made into a hassle-free single disk drive word processor. (It is difficult to do word processing with a single-drive system.)

TELEPATCH (Spectrum Projects Inc., 93-15 86th Drive, Woodhaven, NY 11421) is a self-installing patch for the disk version of Telewriter-64. If you have a single-drive disk system it takes a number of disk swaps to install the patch, but when you're finished you have an upgraded version of Telewriter-64 (the source version isn't destroyed or modified) having thirteen new features, ten of which make the tight-budget CoCo/Telewriter into a powerhouse. The big ten are: 1) All disk I/O in memory (which permits the program disk to be removed); 2) A true block move; 3) Visible carriage returns, which are just great when setting up tables and charts; 4) Key repeat of all characters and the space; 5) Locked-on justified printing (doesn't turn off after a file has been printed); 6) A true RESET which permits a 64K Color Computer to be reset if everything else goes wrong without leaving the editor (no losing your work); 7) Lowercase off on boot (useful when writing BASIC programs); 8) Fast cursor movement (for zipping across the screen); 9) Either overstrike or insert mode (original program provides only for insertion); 10) A type-ahead buffer for people who type faster than the computer can handle the data: if your typing gets ahead of the computer the screen will catch up.

The memory-resident disk I/O requires the most explanation. The problem with most word processing software used with computers having only one disk drive is that the data disk—the one that contains only text files—must be swapped with the program disk when using disk I/O disk routines, such as saving a file, or reading a file, or appending a file: Frequent reads and appends can lead to considerable disk swaps. TELEPATCH eliminates the frustrations of disk swapping by moving all disk routines into memory along with the editing program so that it is never necessary to swap disks for disk I/O: The user can load the TELEPATCHed Telewriter-64, substitute the data disk for the program disk, and go through a complete editing session without having to remount the program disk.

One of the powerful features of the new disk I/O is that the user can instantly determine whether a save will be in binary or ASCII, selecting the one that will be most efficient at the time the document is saved to disk. For example, ASCII is generally preferred if the document will be run through a spelling checker, or is to be transmitted by modem; binary is recommended when maximum speed is wanted for writes and reads.

In order to retain the instant-access of the original Telewriter-64 the user-controlled TELEPATCH functions are command rather than menu driven. For example, a block move is instantaneous when CLEAR-T ("T" for transport) is pressed, similarly the insert/overstrike toggles when CLEAR-O is depressed.

TELEPATCH comes with a new loader that is written in BASIC so the user can conveniently configure the boot so the program comes up with the most desired features as the default. A complete list of pokes for the new features are provided along with the appropriate loader program line number. Among the user-set defaults are black/white or black/green screen, insert or overstrike mode, page numbering sequence, line spacing, lines per page, justified printing, "one page" printing, characters per line, upper, bottom, right and left margins, printer baud rate (300 through 9600), key repeat rate, repeat delay, fast cursor speed, number of disk drives in system (1-3), automatic case (upper or lower), disk verify, default disk drive, and ASCII disk menu.

TELEPATCH also permits the user to specify a disk stepping rate of 6 to 30 milliseconds. This means that you can get the maximum disk access speed if you have splurged for one of the latest model disk drives. On the other hand, it also means that the program will work with one of the original 30 mSec. "clunkers" you might have picked up surplus for something like $25.

The primary limitation of TELEPATCH is that installing the disk I/O in RAM reduces the text buffer size from Telewriter's usual 24,889 characters to 20,793. If, for some reason, you need the extra RAM, or have a two drive system to begin with, you can install TELEPATCH without the disk I/O in RAM. ◀CD▶

SINGLE TRANSISTOR SWITCHING CIRCUIT DESIGN

Jeff Holtzman

Hobbyists dealing with digital circuits are terrified by interfacing. But for computers to do useful things, they must have a way of talking with outside circuits: relays, motors, lightbulbs, LED's, etc. Things aren't so bad when dealing with standard TTL outputs, but what do you do when you have to connect a 5-horsepower motor to a CMOS inverter? Doing that is simple; we'll show you how to do the design calculations, and we'll present a short BASIC program that does the work. One feature of that program is that after making the calculations, it outputs the value of the closest standard resistor.

To design a switching circuit, before doing any calculations, make sure that a single transistor will do the job. There are no calculations involved, just a little common sense. If your driving device is a 6522 VIA, or a Z80 PIO, or similar, and you want to control an NC (Numerical Control) lathe with a 5-horsepower motor, you'll need a few transistors to build up enough drive to control a relay large enough.

If you need to turn an LED on and off, you may be able to use a transistorless driving circuit. You may get by using just a current-limiting resistor, although doing that may not allow the LED to glow at full brightness.

If a one-transistor circuit will do the job for you, choose a transistor. Double the voltage and current requirements of your load device, and then search your databooks and catalogs for a transistor that meets those specifications. Find several that will do, in case your first choice is unavailable, or expensive.

Every transistor has a DC-gain factor, called HFE. Unfortunately, HFE varies from device to device, even between devices of the same type. HFE also varies with load and temperature. Since many applications aren't critical, a few assumptions can be made to get things off the ground. Those will allow you to arrive at tentative values suitable for breadboarding; remember that slight adjustments may have to be made later.

With specifications handy, choose a value for HFE halfway between the minimum and maximum values given in the databook. If you don't have the specs, you can assume a value of 100 for a small-signal transistor, or 10 for a power transistor. That lets you estimate the value of the current-limiting resistor in the base circuit (R1 in Fig.1). As base current is defined as the collector current over HFE, you can get the base current by dividing the collector current by 100, or by 10, depending on the type of transistor. Before finding the value of R1, we have to find the value of R2.

Making the calculations

To calculate the values of the resistors in the switching circuit shown in Fig. 1, work backwards from the load. You have to know how much current the load will draw, and its resistance, to calculate the voltage drop, V(L), that will appear across it. According to Kirchoff's law,

$$V(CC) = V(L) + V(R2) + V(CE)$$

V(CE) is the voltage dropped across the collector and emitter leads of Q1; that voltage is often about 0.3 volt, so it may be ignored. By making that simplification and rearranging our equation we find that V(R2) = V(CC) - V(L). We need the resistance of R2, and by Ohm's law that is equal to the voltage across R2 divided by the current flowing through it, or, R2 = (V(CC) - V(L)) / I(L). If the load is an LED, we can assume that V(L) is 1.5 volt. If not, V(L) must be expressed as I(L) * R(L). In the latter case, the value of R2 would be expressed as R2 = (V(CC) - [I(L) * R(L)]) / (I(L))

To calculate the value of R1, we use the value of HFE we found above. Since HFE = I(C) / I(B), I(B) can be expressed as I(B) = I(C) / HFE.

By Thevenin's law we know that I(C) must equal I(L), so I(B) = I(L) / HFE. Again, by Kirchoff's law we know that V(IN) = V(R1) + V(BE). where V(BE) is the base-emitter voltage drop. For the sake of simplicity, we can assume that V(BE) is zero, so the voltage dropped across R1 must equal the input voltage. Therefore, the value of R1 can be simply expressed as R1 = V(IN) / I(B). Since I(B) can be expressed in terms of collector current, R1 = V(IN) / [I(C)/HFE].

The unknown quantities (R1 and R2) are expressed in terms of the known quantities, so it's time to plug the values into the equations and solve them. Rather than bang those values out your calculator, type the program shown in Listing 1 into your computer and save it for the next time you need to design a switching circuit.

The program provides features you may find convenient. For example, that program can be used to design a circuit with any driving voltage, but if you happen to be using TTL, the program assumes a value of 2.4 volts for V(IN). Likewise, if you will be driving an LED, the program assumes a load current of 15 mA, and a 1.5 volt drop across the LED.

The program was written in MBASIC-80, and it should be simple to translate into other dialects of BASIC. The main routines have been written as

```
10 REM switching transistor circuit
20 REM design  jh  10-22-85  for RE
30 FIRST = -1
40 PRINT CHR$(27);"*";
50 GOSUB 1000
60 PRINT
70 INPUT "Another? ", YESNO$
80 IF LEFT$(YESNO$,1) = "Y"
   OR LEFT$(YESNO$,1) = "y"
   THEN GOTO 50
90 END
1000 REM get and print data for
     switching circuit
1010 PRINT
1020 INPUT "Enter supply voltage
     (VCC) in volts: ", VCC
1030 INPUT "Enter HFE of
     transistor: ", HFE
1040 INPUT "Is load an LED
     (y/n) ? ", YESNO$
1050 YESNO$=LEFT$(YESNO$,1)
1060 IF YESNO$="Y"
     OR YESNO$="y"
     THEN VL=1.5: IL=15: GOTO 1100
1070 INPUT "Enter load
     resistance (RL): ", RL
1080 INPUT "Enter load
     current (IL) in mA: ", IL
1090 VL=IL*.001*RL
1100 IL=IL*.001
1110 INPUT "Does TTL drive this
     circuit (y/n) ? ", YESNO$
1120 YESNO$=LEFT$(YESNO$,1)
1130 IF YESNO$="Y"
     OR YESNO$="y"
     THEN VIN = 2.4: GOTO 1150
1140 INPUT "Enter driving
     voltage (VIN): ", VIN
1150 IB=IL/HFE
1160 R1=VIN/IB
1170 RIN=R1:GOSUB 10000:R1=ROUT
1180 R2=(VCC-VL)/IL
1190 RIN=R2:GOSUB 10000:R2=ROUT
1200 PRINT:PRINT "R1 =";R1;
     "ohms, R2 =";R2;
     "ohms, I(B) =";IB*1000;"ma"
1210 RETURN
10000 REM get closest standard
      resistor value
10010 REM input = rin
10020 REM output = rout
10030 REM sf = scale factor
10040 REM 25 standard values follow
10050 DATA 1.0, 1.1, 1.2, 1.3,
      1.5, 1.6, 1.8
10060 DATA 2.0, 2.2, 2.4, 2.7
10070 DATA 3.0, 3.3, 3.6, 3.9
10080 DATA 4.3, 4.7
10090 DATA 5.1, 5.6
10100 DATA 6.2, 6.8
10110 DATA 7.5, 8.2, 9.1, 10.0
10120 IF NOT FIRST THEN 10190
10130 FIRST = 0
10140 AMAX = 25 : REM must equal
      no of entries in table above
10150 DIM A (AMAX)
10160 FOR I = 1 TO AMAX
10170 READ A(I)
10180 NEXT I
10190 X = RIN
10200 SF = 0
10210 WHILE X > A(AMAX)
10220 X = X/10
10230 SF = SF + 1
10240 WEND
10250 I = 1
10260 WHILE X > A(I)
10270 I = I + 1
10280 WEND
10290 IF X-A(I-1) <= A(I)-X
      THEN X = A(I-1) ELSE X = A(I)
10300 ROUT = X * 10^SF
10310 RETURN
10320 END
```

subroutines for easy integration into your programs. Lines 1000-1210 get the data and calculate the resistor values; lines 10000-10320 select the closest standard resistor values. Lines 10-90 drive the main routine following line 1000. Line 30 sets a flag for the standard-value routine, so that it doesn't read the data contained in lines 10050-10110 in every time a set of calculations are made. Line 40 clears the screen of my CRT (an ADM 20); you'll probably have to use another method.

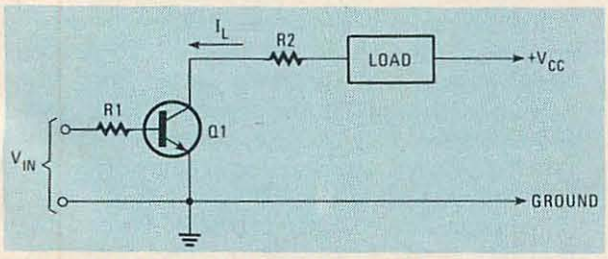

FIG. 1—R1 IN DIAGRAM ABOVE is used for current limiting and must be estimated. (See text.)

If your BASIC doesn't have the WHILE . . . WEND statements, you can simulate them by using an IF . . . THEN statement and a dummy loop. For example, the code below could be substituted for the loop running from line 10210 to line 10240: 10210/IF X <= A(MAX) then 10250
10220 X = X/10
10230 SF = SF + 1
10240 IF X > A(AMAX) THEN 10210
That's about all there is to calculating the values of the resistors in this simple switching circuit. Of course, you should verify that the calculated values actually do the job before building 10,000 duplicate circuits. Also, note that the program prints the value of I(B) the circuit will draw. That was done as a protective measure. If your driving circuit is CMOS, and I(B) is greater than a milliamp or so, you'll have to do one of two things: use a Darlington, or add another transistor that will provide a bit of "preamplification." If you opt for a Darlington, you can use our program as is. ◀CD▶